

INDIANA DEPARTMENT OF TRANSPORTATION
MATERIALS AND TESTS DIVISION

CLASS AP COARSE AGGREGATE
ITM No. 210-01T

1.0 SCOPE

- 1.1** This method sets forth the control procedures used for classification of an aggregate as Class AP.
- 1.2** The coarse aggregate is incorporated into the casting of concrete beams, and the beams are cured and tested in a freeze and thaw cycling procedure. The length of the concrete beams are measured before and after the test to determine the average maximum change in length.
- 1.3** The values stated in either acceptable English or SI metric units are to be regarded separately as standard, as appropriate for a specification with which this ITM is used. Within the text, SI metric units are shown in parenthesis. The values stated in each system may not be exact equivalents; therefore each system shall be used independently of the other, without combining values in any way.
- 1.4** This ITM may involve hazardous materials, operations, and equipment. This ITM does not purport to address all of the safety problems associated with the ITMs use. The ITM user's responsibility is to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2.0 GENERAL REQUIREMENTS.

- 2.1** No testing of the aggregate will be made until the material is rated Class A aggregate; however, the material may be tested for class A and AP concurrently if so directed by the Department. Blending or combining of a ledge that does not meet quality or deleterious requirements will be permitted only by the approval of the Department.
- 2.2** The coarse aggregate Producer shall provide a written description of the production control in the Source Quality Control Plan in accordance with ITM 211. This plan shall specify the ledges to be incorporated into the production for crushed stone, the relative production zone within the pit for gravel, general handling and crushing procedures used in the production, the final production gradation obtained, and any other pertinent information relative to the coarse aggregate production, such as stockpile signage. Any unauthorized change in the approved Quality Control Plan will be cause for the suspension of shipment of this material.
- 2.3** Tests will be performed by the Department Materials and Tests Division, or a Department approved AASHTO Accredited Laboratory until Department tests are available. Department tests results will control the resampling schedule.

3.0 REFERENCES.

3.1 AASHTO Standards.

M 85	Portland Cement
M 92	Standard Specification for Wire Cloth and Sieves for Testing Purposes
M 154	Standard Specification for Air-Entraining Admixtures for Concrete
M 210	Apparatus for Use in Measurement of Length Change of Hardened Cement Past, Mortar, and Concrete
M 231	Weighing Devices Used in the Testing of Materials
T 27	Sieve Analysis of Fine and Coarse Aggregate
T 119	Slump of Hydraulic Cement Concrete
T 121	Mass Per Cubic Meter (Cubic Foot), Yield, and Air Content (Gravimetric of Concrete)
T 126	Making and Curing Concrete Test Specimens in the Laboratory
T 152	Air Content of Freshly Mixed Concrete by the Pressure Method
T 161	Resistance of Concrete to Rapid Freezing and Thawing
T 196	Air Content of Freshly Mixed Concrete by the Volumetric Method

3.2 ASTM Standards.

C 192	Test Method of Making and Curing Concrete Test Specimens in the Laboratory
C 666	Test Method for Resistance of Concrete to Rapid Freezing and Thawing

3.3 ITM Standards.

203	Control Procedures for Classification of Aggregates
207	Sampling Stockpiled Aggregates
211	Certified Aggregate Producer Program

4.0 TERMINOLOGY.

4.1 Terms and Abbreviations. Definitions for terms and abbreviations will be in accordance with the Department's Standard Specifications, Section 101.

5.0 SIGNIFICANCE AND USE. This ITM will be used to classify aggregates as Class AP for use as designated in the Standard Specifications.

6.0 APPARATUS.

- 6.1** Balance, G₂, conforming to the requirements of AASHTO M 231.
- 6.2** Beam molds, conforming to the requirements of AASHTO T 126, except for the dimensional requirements.
- 6.3** Freezing and Thawing Apparatus, conforming to the requirements of AASHTO T 161.

- 6.4** Length Comparator, conforming to the requirements of AASHTO M 210.
 - 6.5** Mechanical Sieve Shaker, conforming to the requirements of AASHTO T 27.
 - 6.6** Oven, appropriate size capable of maintaining a uniform temperature of $230 \pm 9^{\circ}\text{F}$ ($110 \pm 5^{\circ}\text{C}$).
 - 6.7** Sieves, conforming to the requirements of AASHTO M 92.
 - 6.8** Miscellaneous Equipment, such as tamping rods, scoops, trowels, straightedge, mixing bowl, sieve brush, etc.
- 7.0 SAMPLING.** An approximate 300 lbm (135 kg) coarse aggregate sample of the material to be tested will be obtained in accordance with ITM 207.
- 8.0 PREPARATION OF TEST SPECIMEN.**

- 8.1 Coarse Aggregate.** The sample will be separated into the required sieve sizes in accordance with AASHTO T 27. The quantity from each sieve size will be recombined to obtain the following gradation:

<u>Sieve Size</u>	<u>Percent Passing</u>
1 in. (25 mm)	100
$\frac{3}{4}$ in. (19 mm)	95
$\frac{1}{2}$ in. (12.5 mm)	55
$\frac{3}{8}$ in. (9.5 mm)	35
No. 4 (4.75 mm)	0

The sample will be submerged in water for at least 24 hours prior to mixing for beam casting and shall be SSD at the time of mixing.

- 8.2 Fine Aggregate.** The fine aggregate sample will be No. 23 natural sand from Source No. 2310. The sample will be separated into the required sieve sizes in accordance with AASHTO T 27. The quantity from each sieve size will be recombined to obtain the following gradation:

<u>Sieve Size</u>	<u>Percent Passing</u>
No. 4 (4.75 mm)	100
No. 8 (2.36 mm)	87
No. 16 (1.18 mm)	67
No. 30 (600 μm)	42
No. 50 (300 μm)	9
No. 100 (150 μm)	0

- 8.3 Cement.** The cement will be Type I cement in accordance with AASHTO M 85 from Source No. 0002.

8.4 Air Entraining Admixtures. The air entraining admixture will be Daravair-R in accordance with AASHTO M 154 from Source No. 8266.

8.5 Mix Design Parameters. The concrete will have the following properties:

Portland Cement Content	564 lb/yd ³ (335 kg/m ³)
Water/Cement Ratio (Weight Basis)	0.43
Air Content	6.5 ± 1.5%
Absolute Volume of Coarse Aggregate (Saturated Surface Dry)	0.40

8.5.1 The air content will be determined in accordance with AASHTO T 152 or AASHTO T 196.

8.5.2 The unit weight will be determined in accordance with AASHTO T 121.

8.5.3 The slump will be determined in accordance with AASHTO T 119.

8.6 Casting of Test Beams. The beams will be cast in accordance with ASTM C 192 and the beam dimensions will be 3 in. (76.2 mm) x 4 in. (101.6 mm) x 15 in. (381.0 mm) (depth x width x length). At least three beams will be cast. Gage studs will be cast into both ends of the beams. The gage studs will be stainless steel hex bolts 1/4 in. - 20 UNC (6 mm - 20 UNC) x .75 in. (19 mm), with the threaded end finished in accordance with AASHTO M 210.

8.7 Curing of Cast Beams. As soon as the concrete surface is capable of supporting a curing material, the beams will be covered with two layers of wet burlap (or similar material) and one layer of at least 4 mil (0.01 cm) thick plastic sheeting. After 24 hours, the beams will be demolded and placed in submerged curing conditions in accordance with ASTM C 192. At an age of 14 days the freeze-and-thaw exposure will begin.

9.0 PROCEDURE.

9.1 Immediately after the curing period, bring the beams to a temperature of 40 ± 3°F (4.4 ± 1.7°C) in water.

9.2 Measure the length of the beams from stud tip to stud tip using a length comparator in accordance with AASHTO M 210.

9.3 Apply freeze-and-thaw cycling in accordance with ASTM C 666, Procedure B. The freeze-and-thaw unit will be adjusted to achieve 8 cycles per day (approximately 3 hours per cycle).

9.4 Measure the length of the beams at least every 50 cycles throughout the testing at 40 ± 3°F (4.4 ± 1.7°C).

9.5 Continue the test until at least two beams break or until at least 350 cycles are achieved.

10.0 CALCULATIONS.

10.1 Calculate the length change in percent as follows:

$$L_c = \frac{l_2 - l_1}{L_G} \times 100$$

where:

L_c = length change of the test beam after C cycles of freezing and thawing, %

l_1 = length comparator reading of beam at 0 cycles, in. (mm)

l_2 = length comparator reading of beam at C cycles, in. (mm)

L_G = effective gage length between the innermost ends of the gage studs.

11.0 REPORT.

11.1 Test Report Data will include the following items:

11.1.1 Concrete batch weights (masses).

11.1.2 Coarse aggregate source identification.

11.1.3 Type of material.

11.1.4 Gradation of production material.

11.1.5 Ledges of aggregate, if applicable.

11.1.6 Date sampled.

11.1.7 Individual(s) obtaining sample.

11.1.8 Number of beams cast.

11.1.9 Plastic concrete parameters (air content, unit weight, and slump).

11.1.10 Duration of freeze-and-thaw cycle used.

11.1.11 Date of test completion.

11.1.12 Initial length of each beam, length of each beam after C cycles, length change of each beam, and average length change for the beams. Length change values for each beam and the average of all beams will be reported to the nearest 0.001 percent.

11.1.13 Plot of percent length change versus number of cycles for each specimen.

11.1.14 Brief description of any specimen which failed during the test including any distress observed from the beams during the testing.

11.1.15 Retest date.

12.0 AGGREGATE ACCEPTANCE OR REJECTION CRITERIA.

12.1 Aggregate Acceptance Criteria.

12.1.1 Department Acceptance Criteria. The average of all of the beams tested shall be less than .060 percent expansion. Two of three beams shall be less than .060 percent expansion. Broken beams shall be excluded to a maximum of one broken beam per test beam set.

12.1.2 Approved Laboratory Test Results. Acceptance of test results from an approved laboratory will be considered if the test results are less than two years old at the time of submission.

12.2 Retesting of Class AP Aggregate.

12.2.1 AP aggregate sources with an average beam expansion of 0.010 percent or less will be sampled and tested as noted on the source response letter with a maximum of 5 years between tests.

12.2.2 AP aggregate sources with an average beam expansion greater than 0.010 percent but less than 0.045 percent will be sampled and tested at least every two years.

12.2.3 AP Aggregate sources with an average beam expansion of 0.045 percent but less than 0.060 percent will be sampled and tested at least annually.

12.2.4 The Department may approve the retesting of aggregates for AP use by an approved laboratory if prior written request is made and approval is given. In all cases, the Department will obtain the aggregate samples and properly identify them.

12.3 Resampling of Rejected Aggregate. After one year or when enhancing process changes have been made, additional sampling and testing may be considered. Requests for additional sampling and testing shall be submitted in writing to the Chief, Materials and Tests Division with a copy to the appropriate District Materials and Tests Engineer. If less than one year has elapsed, an explanation of the enhancing process changes shall be included.